

**EFFECTIVENESS OF USABILITY LEARNING MODELS AND USER
SATISFACTION IN UNIVERSITIES IN NAKURU COUNTY, IN KENYA.**

**BY
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Technology of
Masinde Muliro University of Science and Technology**

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DECLARATION AND APPROVAL

Declaration

This research thesis is my original work and has not been presented for an award of a diploma or conferment of a degree in any other University or institution.

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ABSTRACT

Effectiveness has been increasingly recognized as a significant quality dimension to determine the usability of mobile applications. Mobile learning applications on the other hand are different in many ways from those innovations due to the mobility nature of mobile devices. Learning institutions in Kenya especially, universities have implemented these scientific innovations as alternative approach to teaching and learning. The uptake was accelerated more with the advent of the Corona Virus pandemic which saw the education sector literally close down. As a way of having their students back to class, majority of the Universities in Nakuru County, adopted the online technologies. Despite the adoption of technologies, there are many complaints from the users, the students, on many inefficiencies coming along with the online learning platform. This puts to doubt the quality of user satisfaction of such technologies in enhancing teaching and learning processes. However, the advent of mobile technologies in learning context has increased the requirements for evaluating the effectiveness of usability learning models to align with user satisfaction in mobile learning applications. Existing metrics concentrates on ease to use, efficiency, reliability and security of the software which has a shortfall since the user is not subjected to contribute in the mobile application development. Even though mobile learning has been studied from different aspects of pedagogy environment and technology acceptance, there is little scientific and published research on effectiveness of usability of mobile learning applications. To fill up the gap, in this study, effectiveness of usability learning models and user satisfaction was established. The main objective of this study was to evaluate the effectiveness of usability learning models on user satisfaction in universities in Nakuru County, Kenya. To serve this purpose, survey questionnaires were issued to sample of university students in the ICT department in Nakuru County in Kenya. The analysis of structured item were mainly done by multiple regression and multivariate analysis from the results of the descriptive statistical tool. The findings from this study contributes to the body of knowledge by coming up with a number of usability guidelines as a significant quality dimension for the design of usable applications in mobile learning that can help improve user satisfactions and reductions in training costs. The decrease in costs attracts many researchers, interface designers and project managers to employ the usability assessment attributes when designing the interfaces for mobile learning applications. The study recommends that given the kind of empirical evidence from the university to consider having a system that is designed with memorability attributes to be considered for the clients to come back to the system from time to time hence improved user satisfaction.

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ACRONYMS AND ABBREVIATIONS

HE	Higher Education
ICT	Information and Communications Technologies
ISO	International Organization for Standardization
MLS	Mobile Learning System
MobiLearn	Mobile Learning
PACMAD	People at the Centre of Mobile Application Development
PDA s	Personal Digital Assistants
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

According to [1] advancement in information communication technology and its applicability in education, has led to a paradigm shift on how teaching learning processes is conducted. It is no longer a requirement for the learner and the teacher to meet in a conventional classroom for learning to take place [2]. With these realities, learning institutions have adopted the new changes in teaching and learning processes hence adopted learning online [3].

[4] States that many learning institutions have adopted a hybrid system in the teaching learning, that is: the conventional physical classroom and the online classroom. This has not come with a myriad of challenges in implementing the online class [5]. In a way to address these challenges, several web-based classrooms resources has been developed in an endeavour to deliver quality [6]. This integration then necessitated the development of a web-based learning management system (WLMS) that could deliver instructor-led lessons using both the physical and online environment [7].

WLMS also included tools for communication, data analytics, monitoring, feedback and reporting [8]. A WLMS is an enhanced form of the e-learning concept that uses various digital formats and communication tools to deliver lessons in a blended environment, that is, a combination of online and physical classrooms [9]. Given that a majority of the top-ranked educational institutions had already implemented online-based teaching techniques, the next logical step was to invest in a WLMS to create and deliver teaching modules, evaluate the course progression, and provide real-time monitoring and feedback [10]. With a WLMS, students can access a complete range of online resources to

supplement classroom material, which in turn, is expected to influence user satisfaction [11] (Tsai et al., 2019).

Global perspective of usability models on mobile learning for user satisfaction

In their study [12] where there proposed model, interface usability issues of mobile learning applications for smart phones, was compared with similar mobile application based specially based on blackboard at western university London. The two models were evaluated in terms of ease of use, user satisfaction, attractiveness, and learnability. The results of the questionnaire showed that the participants considered the user interface based on our proposed framework more user-friendly as compared to the Blackboard-based user interface.

A study by [13] based on the platform independent mobile learning tool for structured programming course, and evaluate its effectiveness and usability using ADDIE instructional design model (ISD) as M-LT life cycle. J2ME (Java 2 micro edition) and XML (Extensible Markup Language) were used to develop platform independent mobile learning tool. The results show that the system was effective and also usability evaluation was positive. Whereas this study established a significant and positive relation between development and usability evaluation of platform independent mobile learning tool there is a dearth in information on the usability satisfaction and usability models in Kenyan context and specifically at the Universities in Nakuru County.

With the advance of modern technology, the society has been transformed to 'mobile society [14]. To evaluate and increase the chance of the successful development of new mobile learning products, the adoption of a complete and well-defined set of technical quality aspects for mobile learning development and their adoption in the education environment are proposed [15] Whilst some research has been examining the

functionality of mobile learning systems, little attention has been paid to usability issues. From the previous study, many researchers have investigated the usability in the mobile applications. Studied by [16] performed a new usability model applied to mobile devices namely People at Center of Mobile Application Development (PACMAD). This model is the model that integrated the usability model developed by [17]. This studied has reviewed the limitations of the mobile applications which suggested by [18].

It should be noted, too, that the properties that software usability takes on might vary, depending on the target audiences of the software system. The diversity of different viewpoints, and their related usability requirements, has led to different perspectives on usability in the various ISO models that have been developed over the years by different groups of usability experts. However, it remains to be seen how far m-learning systems are conforming to these standards, and where the conflicts might be between educational features and usability. Academic institutions need to meet usability demands and fulfill government targets to deliver widening access to Higher Education, and this can only be achieved by evaluating m-learning information system usability and identifying continuing usability needs. Therefore, a set of quantity metrics according to the attributes of the usability model in mobile applications needs to develop. This evidence of acceptance has implications for educators and curriculum designers to discover ways of exploiting the mobile phone for independent and interactive learning outside the classroom [19].

According to [20] it is noticeable that usability issues are often reported where PDAs have been used, which suggests that PDAs might be the object of more usability problems than is the case for mobile phones, for instance. Many Usability Models which have developed so far for the specification and measurement of usability of software, had some

major drawbacks as they lacked support of all usability aspects, testing tool support and were not well integrated into current software engineering practices. Similarly, it was noted that definitions given by experts and researchers have not yet been harmonized. For instance, usability model ISO 9241-11 was developed by a group of experts specializing in Human-Computer Interaction, whereas the ISO 9126 model was developed by another group of experts specializing in software engineering. This illustrates that the models of usability that are currently being proposed to the industry are not yet mature and that further work is required to develop a greater consensus on an improved and more comprehensive model.

A study by Emmanuel, [21] in, Malaysia showed that the top four usability quality attributes are efficiency, effectiveness; learnability and user satisfaction. The studies reviewed showed that usability evaluations were conducted during implementation phase only, and evaluation is often built as a description of the case study. Whereas this study was done in Malaysia and provides information to the effect that evaluation of the usability models have only been evaluated at implementation stage, there is paucity of information on the usability models and user satisfaction in the study area. This is the gap that this study endeavored to fill.

1.1.2 Regional Perspective of Usability Models on Mobile Learning

A study by [22] established that heuristics evaluation is a proper, effective and fast usability evaluation method of m-learning applications with better results than the qualitative user testing, but still 26% of problems identified by students were not identified by experts. Whereas this study established a positive relationship between mobile learning usability attribute testing methodology and effectiveness of mobile

learning in Nigeria, there is paucity of information on the effectiveness of the available user models in Kenya and particularly in Universities in Nakuru County.

1.1.3 Local Perspective of usability models on mobile learning for user satisfaction

According to [23] Kenya has really invested in the development and use of mobile learning systems. However, like many developing nations, this mode of learning remains as its pilot stage defined with many challenges and who satisfaction on user satisfactions remains unreported. This presents a challenge in improving learning and meeting learners' expectations using mobile technology. There is also need to ensure that mobile learning systems add value to learning by providing relevant technologies that meet users' expectations hence this study.

In order to align with mobile learning applications in the advent of mobile technologies in learning environment has been increased the requirements for developing appropriate usability model. Based on the literature [24] a usability evaluation model with the inclusion of timeliness is developed to assess the usability of mobile learning applications. Timeliness or response time as an important feature in mobile learning, which influences learning satisfaction, can be considered to evaluate the peers and instructors' timely response.

According to [25] most existing computer-based Learning Management System still do not have advanced access support for mobile devices, and there are deficiencies in cross-platform these solutions. Even more, many mobile device's browsers do not support scripting or plug-ins, and do not have available memory to display desktop web-pages and graphics. This influences a lot the usability of mobile learning systems. Also, web content that is mostly the format of electronic learning content is not always suited for mobile browsers and the ability to display information in various multimedia formats is

limited. These usability issues of mobile devices and learning must be considered when identifying usability evaluation features and providing a framework for developing cooperative and interactive mobile learning [24].

Based on [26] the organization process was modeled with purposes to apply metrics for measuring the usability as a software quality attribute according to standard ISO 9126. The next challenge is to evaluate the usability of the models from the point of view of the user according to standard ISO 9241-11 that defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [26, 27]

According to [28] confirms that the perceived ease of use and perceived usefulness are key variables that positively influence teachers' intention to use mobile technologies. Self-efficacy is also found to be significantly related to teachers' behavior intention in using mobile devices in their classroom followed by the factor of mobile anxiety. For example [29] investigated the intention to develop a framework that assists in understanding students' behavioral intention to use mobile Learning-systems in a higher-education setting.

Many studies examined the most frequently used usability evaluation metrics without taking into account which usability attributes were included. For instance [30] found that student perceptions can be used to determine the factors that are likely to be influenced by the characteristics of mobile devices, students' skill levels and the interaction with other users. The university administrators and IT staff can incorporate acceptance factors into the university implementation of M-learning. A previous literature review on the mobile-learning studies showed a lack of specific usability metrics for mobile-learning environments [25].

1.2 Statement of the Problem

Literature from the background study has shown that with the advent of scientific innovations, many learners irrespective of geographical location from the learning institutions and socio-cultural diversities have an opportunity to access education and learning. Learning institutions in Kenya especially, universities have implemented these scientific innovations as alternative approach to teaching and learning. The uptake was accelerated more with the advent of the Corona Virus pandemic which saw the education sector literally close down. As a way of having their students back to class, majority of the Universities in Nakuru County included, adopted the online technologies. Despite the adoption of technologies, there are many complaints from the users, the students, on many inefficiencies coming along with the online learning platform. This puts to doubt the quality of user satisfaction of such technologies in enhancing teaching and learning processes. This study therefore was out to establish an evaluation of usability models on mobile learning for user satisfaction at Universities in Nakuru County, in Kenya.

1.3 General Objective

The general objective of the study was to evaluate the effectiveness of usability learning models on user satisfaction in universities in Nakuru County, Kenya.

1.4 Specific Objectives

The study adopted the following study objectives

1. To determine the influence of system efficiency on mobile learning user satisfaction at Universities in Nakuru County, in Kenya
2. To establish the effect of system response Time on mobile learning user satisfaction at Universities in Nakuru County, in Kenya

3. To find out the influence of system memorability on mobile learning user satisfaction.
4. To assess the effect of system learnability on mobile learning user satisfaction on mobile learning system user satisfaction.

1.5 Hypothesis

- H₀₁** There is no statistically significant relationship between system efficiency and effectiveness and mobile learning system user satisfaction.
- H₀₂** There is no statistically significant relationship between system response time and mobile learning system user satisfaction.
- H₀₃** There is no statistically significant relationship between system memorability and mobile learning system user satisfaction.
- H₀₄** There is no statistically significant relationship between system learnability and mobile learning system user satisfaction on mobile learning system user satisfaction.

1.6 Significance of Study

The study was significant for the study in several ways as described below:

1.6.1 Policy

The study would be used by the policy makers to create informed policies around the subject of usability models on mobile learning. It can also be used to support policy making in m-learning and also as a baseline of information for developing a new system.

1.6.2 Learning Institutions

Recommendations from this study would help institutions of learning to come up with practical solutions in the online systems for the betterment of the learner satisfaction as well as handle any challenges that come with this media of teaching learning.

1.6.3 Scholars and Researchers

Researchers and scholars are also expected to benefit from the findings of this study with additional knowledge on usability models and mobile learning. Researchers and scholars can also use this study in their literatures as they analyse the contributions of various readers on the subject matter.

1.7 Scope of Study

The study was delimited to an evaluation of usability models on mobile learning for user satisfaction at Universities in Nakuru County, in Kenya. The study used university students in the department of information communication technology as the key respondents.

1.8 Assumptions of the study

One of the assumptions of the study was that the universities had adopted the usability models which influences mobile learning hence, affecting user satisfaction at Universities in Nakuru County. The other assumptions was that the respondents would give crucial information as pertains usability models and mobile learning for user satisfaction

1.9 Operational Definitions of Terms

Efficiency	This is the ability to produce an intended result in the way that results in the least waste of time, effort, and resources.
Effectiveness	This is the ability to produce a better result, one that delivers more value or achieves a better outcome
Learnability and mobile learning system	This is the quality of products and interfaces that allows users to quickly become familiar with them and able to make good use of all their features and capabilities.
Memorability	This is the measured by the ease of reestablishing proficiency after a period of not using the system.
Mobile Learning	This is a form of distance learning and teaching where electronic materials are delivered and that happens when the users is interacting through a mobile device
System Response Time	This is the time between when the user (student) initiates an action, and when the computer starts to display the result.
Satisfaction	The degree to which a system is giving contentment or making the user satisfied.
Usability models	This is a quality attribute that assess how effective a user interface are to the user in this case the university students.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The following section presents review of literature on various aspects related directly or indirectly on effectiveness for mobile learning applications user satisfaction. The section also included the theoretical and conceptual framework.

2.2.1 System Efficiency on Mobile Learning System User Satisfaction

[32] Indicate that information quality, system quality, and service quality have a positive effect on user satisfaction, and the subsequent user satisfaction has a positive effect on net benefits. The multi-group analysis revealed that all the paths were significant for high SDL groups, whereas for low SDL groups, a path between information quality and user satisfaction was not statistically supported. These results suggest that a differentiated strategy based on SDL level is needed to improve user satisfaction and the net benefit of the mobile LMS. The results are expected to provide implications for the stable operation of mobile LMSs for cyber universities.

E-learning has become main stream in the education sector, especially, finding favor in higher education [33]. An instructor can use various technologies as means to impart e-learning. E-learning usually applies to all online learning that takes place via the internet [33]. In reality, the eLearning system is a World Wide Web-based educational program which offers versatile student education. The development of new technology has undoubtedly opened gates to provide anytime and anywhere learning, thus, extending reach to a widely dispersed population with access to the Internet, and a device such as laptop, computer, tablet or mobile [34]. This being said, without understanding the critical features, the implementation of the most innovative and recent technologies is

pointless. Rather than having any academic reach, such implementation may just be a promotional exercise.

There is no question that in a dynamic and decentralized world, the Internet and other emerging technologies are enabling e-learning. Because of the variations in certain areas between conventional learning and e-learning, there is a need for efficient and productive transfer of conventional programs to e-learning [33]. The shift may involve a complicated undertaking that involves adequate preparation, tracking, and supervision. Besides, the consistently increasing worldwide demand for eLearning has prompted the adoption of web-based environments; however, these need to be first evaluated based on their performance [34]. The success of e-learning education depends highly on WLMS implementation and its adaptation by the end-users [8]

Since the application for smart mobile phones is in high demand and competitions are getting higher in mobile application store markets [30], many developers tend to develop mobile applications faster. Testing is a very important aspect to ensure the application does not lack any usability aspect. The applications are tested on both emulator and mobile devices in order to understand their behavior on different platform [29]. Most teachers receive IT training by attending teacher training courses. Due to their weak IT background and the special needs in their work, the traditional lecture-based approach, which is adopted in many computer courses, are ineffective and boring.

Education applications for mobile devices motivate and grab their attention while helping them focus on solving their problems, improve their memory, reading and writing. In addition to the traditional classroom context, the use of advanced technology in the learning process and evaluation through mobile learning test applications allow students

to manage the use of time according to their needs for personalized experience [1][3-5] [7].

Usability is defined by the ISO as “the capability of a software product to be understood, learned, used, and attractive to the user, when used under specified conditions” [17]. The usability of applications in the learning environment are evaluated by using a more generic approach in the study of usability such as learnability, efficiency, memorability, user satisfaction, effectiveness, simplicity, performance and understanding [20,21]. Usability defines how easily children complete certain tasks, how fast their performance is and how many mistakes they make during the process [28]. These are measured through usability testing. The understanding and readability of the content and the ability to remember information and application function is part of a significant evaluation results that help in the modification of the applications [23]. Another approach to improving usability is to make the user interface or content adapt to the user. Making information personally valuable in a given context is one way of adapting to the user. The diversity of reasons for the use of mobile technologies in education makes it difficult to make any generalizations about requirements. Nevertheless, there are attempts to characterize these requirements, in relation to interface design and usability.

Usability is typically considered from the point of view of issues or problems encountered by users, but good usability essentially means that learning can proceed without obstacles and might even be enhanced by the availability of certain features. One of the key components of a successful and acceptable educational application is ease of use [21] [26]. Several high-quality applications available in the market actually lose out because of their complexity, unattractiveness and confusing user interface. Thus, when designing a user interface for mobile phones, especially for education purposes, the user

requirements of these devices should be considered [2] [24]. In fact, usability has been less extensively covered than the technological aspects of the mobile education application. Mobile technology can be successful as an educational platform only when the future research into the area of m-Learning includes fruitful discussion on all aspects of usability like: learnability, understandability, ease of use, effectiveness, and efficiency of mobile applications [2] [25]. According to [25] any usability testing methodology has to account for the current limitations of mobile devices that are supposed to be used as learning mediums and has to provide information on the ease-of-use, effectiveness and efficiency of the mobile user interface. There are a series of known usability issues of the mobile devices that can affect the overall usability of the m-Learning system: small screen sizes, low screen resolution or the form factor, low storage capacity and network bandwidth, limited processor performance, compatibility issues, lack of data input capability, short battery life, the use of the devices more often on the move.

2.2.2 System response Time on mobile learning system user satisfaction

Studies by [35] in china demonstrate that response time not only adversely affects user experience of mobile applications, but that this effect is not homogeneous across the three dimensions of tolerance, acceptance and satisfaction. The findings also illustrate that gender moderates the effect of response time on user experience, however, the negative influence is more salient for males than females, which is opposite to our hypothesis. Unlike this study which was carried out in china, the proposed study wanted to establish the relation of the user models and users satisfaction at Universities in Nakuru County Kenya.

This study showed that indeed satisfaction does decrease as response time increases. It also showed that that for discretionary browser-based applications, there appears to be a

level of intolerance in the 12-second response range. Some response time delays actually contributed to perceived ease-of-use. Clearly, the internet will not deliver these kinds of response rates any time soon. But there may be other things that browser-based applications can provide to the user without lowering satisfaction or losing the customer.

[36] Studied user perception of computer system response time and suggested that a model of user perception is central to the design effort. Computer system response time is generally defined as the number of seconds it takes from the moment users initiate an activity until the computer begins to present results on the display or printer [37]. User initiation could be a keystroke, mouse click, touch screen, or voice instruction. Shneiderman defines “user think time” as the number of seconds during which the user thinks before entering the next command.

[37] Proposed the ideal response time to be around two seconds. He also speculated, purely by observational means, that a user could detect a change of $\pm 8\%$ in the 2-4 second response time category. Shneiderman agrees with Miller’s findings that a two-second limit is appropriate for many tasks, as long as the monetary cost is not excessive (1998). But there is a wide discrepancy between what is appropriate and what is acceptable. According to Shneiderman, response times longer than 15 seconds are disruptive (1998). However, very rapid responses can be unsettling and lead to higher error rates [37].

In the past 25 years, research in the area of system response time has pointed to a very short (1-2 second) response time being satisfying to the user. But how long will a user wait for a system to respond before becoming dissatisfied and frustrated? System response time doesn’t draw as much attention in the research spectrum for all the controversy it raises. In a 1994 Computerworld survey, Burden describes ratings for

popular system management software (1994). Survey results showed that one of the primary items of importance in a systems management package is performance, a view shared by client/server trade press [39].

2.2.3 System Memorability on mobile learning system user satisfaction

System usability, impacts on user's satisfaction, learnability and memorability of the contents of a system to abate interaction errors which provides for an effective and efficient learning environment [40]. Mobile devices offer plentiful learning opportunities for users, but face challenges such as different screen sizes, different screen resolutions, limited processing power, moderate input capacity, restricted network bandwidth, and network unpredictability [41]. As the field of eLearning innovations advances by leaps and bounds, the ultimate success of the learning pedagogy relies upon the human factors exhibited whilst using mobile and wireless technologies [42].

Although the use of mobile learning is very useful, there are minimum students adopt mobile learning despite the increasing use of mobile devices [43].

According to [44] analyze the impact of Mobile Learning the relationship between various factors from the perceived usefulness, perceived ease of use of such attitudes and behavior intention to, in order to explain user's acceptance of new technologies and how these factors role, so as to provide theoretical support and technical services for effectively promote and facilitate Mobile Learning. Based on the above analysis on the technology acceptance model, Perceived usefulness, Perceived ease of use and External variables can make a very important influence for the user to receive and adopt new technologies [45]. It has been found in the literature that mobile-learning context is not necessarily similar to other IS, and therefore UTAUT core constructs may not be sufficient in determining a user's behavioral intention [45].

Firstly, it has been found in the literature [46] that mobile learning use some portable mobile devices to learn at a certain learning environment; secondly, learning content and information to other support services need to have the technology to support, generally, it must be the technology of mobile communications; finally, mobile learning had to use the computer technology and in accordance with the education technology function to achieve the interaction between teaching and learning activities. In order to gain maximum benefit for Mobile learning [47] introduces MobiLearn in education in general, and in higher education in particular, appropriate enhancement might be required to answer and support user needs, and any suggestions received after the system's deployment.

2.2.4 System learnability on Mobile Learning System user Satisfaction

Mobile technology can improve students' learning experience and performance. This is achieved by providing extendable learning environments, and by motivating adaptive and collaborative learning outside the classroom context [48]. One of the difficulties faced by mobile learning application developers is that mobile devices have presented new usability challenges that are difficult to model using traditional methods of usability. The study of human computer interaction (HCI) for mobile devices started more than a decade ago but still there is large research activity due to recent advancements in mobile devices and the introduction of newer and more sophisticated version of mobile phones over the years.

The technical limitation of mobile devices and achieving high level user satisfaction is critical to the success of mobile applications hence usability testing of mobile learning applications is mandatory process to ensure that mobile learning application are practical, effective, and easy to use [49]. Usability Studies have been recognized as a fundamental

tool in evaluating mobile applications [50] however, very few usability tests have been developed for mobile learning applications.

According to [51] learnability can be measured by investigating various factors such as: User interface: visibility of operation; feedback; continuity of task sequences; design conventions; information presentation; user assistance; error prevention, Conformity of user's expectations: differences in functionality; differences in interaction styles; concept clarity; completeness of information, Training: Conceptual information; exercises; instruction of basic interaction; instructions for solving problems; motivational content; coverage of system functionality and material types.

Another study on learnability by [52] compared the meaning of learnability for child and adult users. The comparison of the meaning of the learnability principle for children and adults using an unfamiliar software application yielded significant results for software designers and practitioners in general. Thus they came up with a new learnability sub-principle known as engageability.

The word engageability was derived from the word engagement. Engagement is a goal of interface design; it is also the main focus in the well-established frameworks of flow theory and play theory [53]. Engageability occurs when a person loses himself or herself in an activity, losing all track of time and not noticing anything outside of the activity. The end result ultimately aided in the reformulation of the learnability principle in a way that distinguishes between the needs of adults and children. Whereas this study provided information on learnability attributes from the children perspectives, the proposed study endeavoured to fill the gap by looking at the learnability attributes from the university students perspective.

According to [54], mobile devices have much potential to support older adults in their daily lives. However older adults have reported that they find mobile devices, such as existing mobile phones, difficult to learn to use. They argue that more research is needed to improve the learnability of mobile software applications for older adults. Whereas the this study looked at application mobile application in learning,

The main aim of usability evaluation is to investigate possible problems of a system and discover ways to resolve those problems. Usability analysis is an important step in software development in order to improve certain aspects of the system [55] However, it is often a challenge especially when it comes to evaluating applications running on mobile devices because of the restrictions posed by the device and the lack of supporting tools and software available to collect the necessary usability data [29]. According to [56] in usability evaluation framework of mobile application aims to identify the main issues in the user interface that may lead to human error, terminate the user interaction with the mobile application and cause user frustration.

[57] indicated in their study that children between the ages of 8 and about 14 years require engageability to improve their learning to use of a new application software this being and important factor in their learnability, this is not to mean that other users of a different age do not require this principle but the degree to which it affects them is different. As for the older kids (15 to 19 years), the findings indicated that they strongly require discoverability to improve their learnability of new application software, this is not to mean that adults or children of different ages do not require this given principle but to say the degree to which varies.

2.2.5 User Satisfaction

[58] States that a strong relationship between organizational factors (top management support and change management) with e-learning system quality, which has never been known before. In addition, the results show that quality factors (course content quality, system quality and service quality) have a positive and significant effect on students' satisfaction of e-learning system quality. Therefore, educational institutions seeking to achieve greater benefits from e-learning systems should pay considerable attention to the quality factors and organizational factors during the design and implementation process of their systems, because of the important role of these factors in enhancing e-learning system quality and e-learning service quality.

The ISO has developed different standards on usability, and two major categories can be distinguished: Product-oriented standards (ISO 9126 and ISO 14598), Process-oriented standards (ISO 9241 and ISO 13407). ISO/IEC 9126 is an international standard for the evaluation of software. It will be overseen by ISO 25000:2005, which follows the same general concepts. The quality model established in the first part of the family standard (ISO/IEC 9126-1:2001 "Software engineering – Product quality – Part 1: Quality model"), describes a two-part model for software product quality: a) internal and external quality, and b) quality in use. It categorizes internal and external quality attributes into six characteristics: functionality, reliability, efficiency, maintainability, portability and "usability". The "usability" is "the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions". It is subdivided into sub characteristics (understandability, learnability, operability, attractiveness and usability compliance) that can be measured by internal or external metrics.

According to [59] suggests a set of usability dimensions that should be considered for designing and evaluating mobile applications based on ISO 9126. The three main elements used are understandability, learnability and operability. ISO 9241-11 defines usability as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11:1998 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability.)

Neilsen Usability Model [60] is as follows: efficiency, user satisfaction, learnability, and memorability and user errors. Nielsen had studied usability and identified the five elements to be appropriated for application development since 1993. Mobile application usability element is the many characteristic used to measure the quality of an application [61]. In the study, Zhang & Adipat identified nine elements: learnability, efficiency, memorability, user error, user satisfaction, effectiveness, simplicity, comprehensibility and learning performance.

[62] in their work entitled "Usability guidelines for developing mobile application in the construction industry", explores that today's advanced mobile devices are very suitable for the construction industry because of its small size, easy to carry and have a wide range of support functions that can be leveraged into mobile applications to help workers in this industry carry out everyday tasks. However, some mobile applications are not very effective because their development is not based on the guidelines usability of mobile applications such as ISO9126, People at the Center of Mobile Application Development (PACMAD) model and Mobile application Usability Elements. The study identifies usability elements of mobile applications for the construction industry as well as developing detailed usability guidelines of mobile applications based on the selected

element for the construction industry. Usability guideline in the area of field work proposed the following elements: efficiency, demand of user attention, presentation, human-computer interaction, navigation and data sourcing map. In order to ensure the usability applied operates effectively, hardware requirement for mobile devices should also be specified.

[63] Conducted study on “An initial theoretical usability evaluation model for assessing defense mobile e-based application system”. This study proposed a new structure of usability model framework for assessing usability in mobile applications. The structure of the model is called GAM consists of goal, attributes and metrics. The study is designed to achieve fifteen major attributes: Accurateness; attractiveness; behaviorness; cognitive load; effectiveness; efficiency; effortlessness; errors; learnability; memorability; operability; satisfaction; steadiness; timeliness; and understandability. As a results, a usability framework based on the sequence of Goal, Attributes and Metrics (GAM) is developed in which outlined metrics is used for measuring the different attributes. This framework can be used for constructing usability model for assessing usability in mobile applications.

[64] In their work entitled “M-learning and their potential use in the higher education: A literature review” describes M-learning as a teaching-learning methodology that uses mobile and portable devices that have some form of wireless connectivity. The use of them offers the opportunity to learn anytime and anywhere; the only requirement is to have access to Internet. The technology is strongly influencing the educational world, in particular, in the students training. Based on a literature review, this article discusses how mobile devices help the teaching and learning process. The analysis of the literature detected five relevant topics on how mobile technologies are being used in today's

education: ubiquity, portability, mobility, usefulness, collaboration, perception and acceptance of m-learning. Current education cannot be limited to the classroom or to a desk; users need to keep the possibility of moving, interacting and collaborating among various users. [64] In his research responds to the question “Do mobile device users use their mobile devices to support intentional informal learning?” The response was an astonishing “yes”. Given the evidence that mobile devices play an important role in formal learning scenarios, it is expected that users with experience in the use of mobile devices will use them as support tools in their informal learning.

[15] In their work entitled “Development of mobile learning application based on consideration of human factors in Oman” emphasizes the importance of considering human factors when developing mobile learning applications. They demonstrated and discussed the results of a study of twenty-three different higher education providers in Oman, with three scenarios involving administrators, instructors and students. Ultimately, the article proposes a MobiLearn framework to enhance the learning process in the current education system through the application of six human factors: flexibility, suitability, sociability, efficiency, enjoyment, and economics. One of the requirements of M- learning moving forward is that it needs to become more personalized and learner-centered to increase learning flexibility and efficiency. Currently, however, the use of mobile technology in learning does offer students greater mobility and extended functionalities, relative to those afforded by desktop computers. The in-built features of mobile devices support access to learning materials at anytime and anywhere.

[65] in their work entitled “Usability evaluation of mobile applications using ISO 9241 and ISO 25062 standards” presents an empirical study based on a set of measures to

evaluate the usability of mobile applications running on different mobile operating systems, including Android, iOS and Symbian. The aim was to evaluate empirically a framework that was developed on the use of the Software Quality Standard ISO 9126 in mobile environments, especially the usability characteristic. For that to be achieved, 32 users had participated in the experiment and used ISO 25062 and ISO 9241 standards for objective measures by working with two widely used mobile applications: Google Apps and Google Maps.

2.6 Conceptual Framework

The objective of the study is two pronged. First, to evaluate the usability features of mobile learning systems (MLS) in higher education institutions, and secondly to see how factors like educational level, experience with similar systems, and mobile device influence, have impact in the usability of m-learning that suite the environment of higher educational institutions. In order to evaluate the appropriateness and effectiveness of the usability for mobile applications, a literature review was conducted to review current approaches and to determine the need for a comprehensive usability that includes learnability and Memorability.

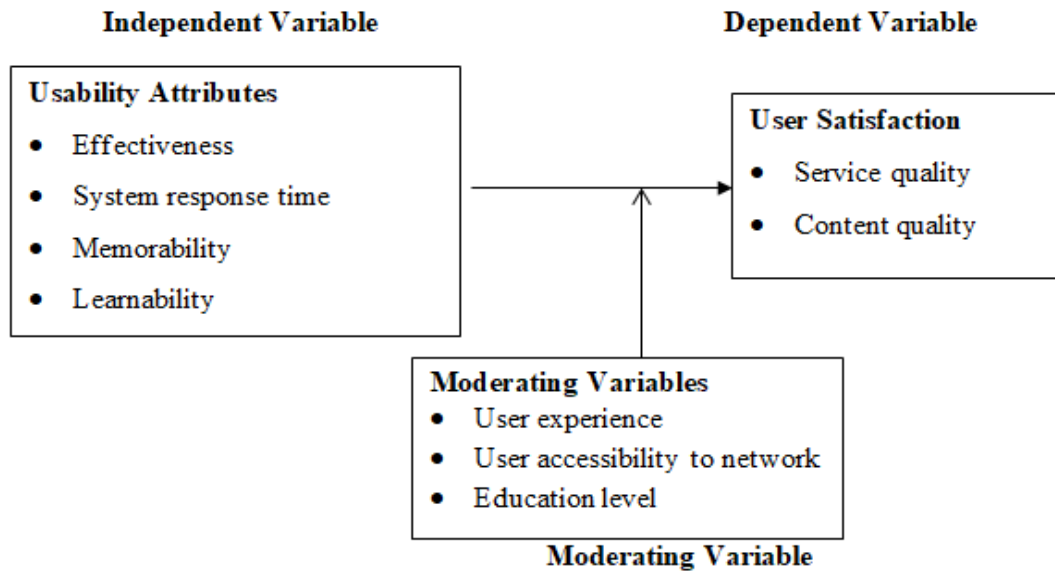


Figure: 1.1 Conceptual framework of the study

Figure 1.1 shows the conceptual frameworks of the study variables. The independent variables include the effectiveness, system response time, memorability and learnability. The observed variable was user satisfaction which was measured in terms of service quality and content quality. The intervening variable that the study took care not to intervene with the study included the user experience and exposure to technology. Gathering data on the extent of m-learning usability evaluation in the higher education institutions were based on models of m-learning by notable m-learning gurus. Amongst the dimensions investigated are extents of m-learning learnability, effectiveness, and efficiency, memorability, timeliness and usefulness issues. Unlike the cognitive domain, in which there are established theories that provide a unifying framework to describe the cognitive process that takes place in learning, there is still much to be understood about how affective factors interact with cognitive factors to produce learning. Usability is significant, not only to increase accuracy, but also to decrease the response time of the range of tasks accomplished by the users of the system.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 The Study Area

The study was carried out in Universities in Nakuru County in Nakuru County. Nakuru County lies 1850 meters above sea levels on the highlands of Kenya giving it a climate similar, albeit a bit colder, to Nairobi. Like most rift valley cities, Nakuru enjoys a temperate climate throughout the year but temperatures fall significantly at night and during the cold season of June to August. The city has a warm-summer Mediterranean climate. Agriculture, manufacturing and tourism are the backbones of the economy of Nakuru. With a population of 2,162,202 (2019 census), it is the third most populous county in Kenya after Nairobi County and Kiambu County, in that order. With an area of 7,496.5 km², it is Kenya's 19th largest county in size. Nakuru borders seven counties; Laikipia to the north east, Kericho to the west, Narok to the south west, Kajiado to the south, Baringo to the north, Nyandarua to the east and Bomet to the west. It covers an area of 7496.5 square kilometers. The area surrounding the city is known for its vast agricultural potential with numerous small farms and also vast agricultural enterprises. The main crops grown around Nakuru and marketed in the city include coffee, wheat, barley, maize, beans and potatoes. Nakuru is also an important educational center. It is the home to both public and private universities making it an ideal study area for this study.

3.2 Research Design

According to [66] a research design is a strategy for data collection and analysis to generate answers to the research problem. This study will employ a survey design. According to Best [67], survey design is about conditions that prevail; rehearses that win;

convictions, perspectives or mentalities that are held; forms that are going on; impacts that are being felt or patterns that are developing.

3.3 Target Population

A target population is the sum of all the units of study which a scientist wishes to consider for the expected objective of the study [68]. In this study the target population will be a cross section of ICT departments of the four universities in the school sciences of Mount Kenya University, Universities in Nakuru County and Laikipia University. Making a total of 542 respondents as shown in table 3.1.

Table 3.1: Target Population of the study

Category	Target population
ICT Department	4
Mount Kenya	100
Kabarak University	121
Egerton University	206
Laikipia Campus	101
Total	532

3.4 Sample Size and Sampling Procedures

The sampling plan describes the sampling unit, sampling frame, sampling procedures and the sample size for the study. The sampling frame describes the list of all population units from which the sample will be selected. According to [69] an optimum sample is one that fulfills the requirements of efficiency, representativeness, reliability and flexibility. This study will utilize Yamene formula in establishing the sample from the study population as shown.

$$n = \frac{N}{1 + Ne^2}$$

Where n=Sample size

N =population and e being the margin of error. The formula uses 95% confidence $p=0.05$ are assumed. Hence,

$$n = \frac{532}{1 + 532(0.05)^2}$$

$$n = \frac{532}{1 + 1.33}$$

$$= \frac{532}{2.33} = 228.3$$

Since there is no a half of a human being, the sample was rounded off to a whole number, 228. The sample was then distributed in first by purposive sampling technique to select all the ICT department respondents then the rest of sample was then equally distributed in the ratio of the study population to each of the universities. Hence, 45, 52, 87 and 44 students were randomly selected to represent the study population in the study as shown in the sample distribution in table 3.2.

Table 3.2: Sample size distribution

Category	Target Population	Sampling Technique	Sample Size
ICT Departmental Heads	4	Purposive sampling	4
Mount Kenya	100	Random sampling	42
Kabarak University	121	Random sampling	52
Egerton University	206	Random sampling	87
Laikipia Campus	101	Random sampling	43
Total	532		228

3.5 Research Instruments

A research instrument is a tool which assists in measuring a variable(s) of the study [70]. Survey methods can collect quantitative using questionnaires. This study therefore will use questionnaires to collect quantitative data from the responds.

3.5.1 Questionnaires

According to [70], a questionnaire is a research instrument comprising of a succession of questions and other prompts used for gathering information from respondents. Questionnaires are suitable instrument for the study since it can reach a many respondents within a short time. Since the study will utilize the drop and collect later system respondents will have sufficient time to react to the questions without surge. Questionnaires are able to give a feeling of confidentiality since respondents are not required to give their names on the instrument. The questionnaires for students will be divided into two sections. Section A, will give personal and general information while section B will seek ethical issues as study objectives as captured in Appendix B.

3.6 Piloting

To guarantee that the tools for data collection are precise in the collection of pertinent information, they will be subjected to a reliability and validity test [70]. A piloting sample was made up of 10% of the sample size drawn from a simple department of Universities in Nakuru County which was not subjected to actual data collection as explained below:

3.6.1 Validity

The term validity as applied in this research alludes to the appropriateness; meaning and usefulness of any inferences a researcher draws in light of data obtained using an instrument [71]. To attain reasonable content validity, the researcher will seek for opinions from colleagues and experts-the supervisors. According to [70], tools of data collection ought to be valid if they have to produce useful and accurate information. It can only be said the tools have provided valid results when they measure accurately what they are intended to measure. The instruments will be checked for content validity by the

supervisors to ascertain whether the items are clear and can lead to obtaining relevant data. Also, On the other hand, construct validity will be assessed using factor analysis (FA) results. Items meant to measure a given construct group together and different from items measuring a different construct. Example, to demonstrate construct validity in FA procedure, items measuring efficiency construct should hang together from items meant to measure learnability construct. However, researchers recommend first checking for the suitability of the data to be subjected to FA using the KMO and Barttlets test statistics. The KMO should be atleast 0.7 and the Barttlets statistic should be significant ($P < 0.050$) this study implements these standard guidelines in the FA procedure.

3.6.2 Reliability

Reliability of an instrument is the level of consistency with which the research instrument measures whatever it was planned to measure and yields consistent outcomes [72]. The study used the commonly used Cronbach's alpha test. The Cronbach's test is post data collection test of reliability- the extent the instrument is consistent in measuring what it set to measure, It is a score ranging from zero (no reliability) to one (high reliability). Researcher recommends reliability of an instrument should have score of at least 0.7 and this study used this threshold to confirm or assess the instrument's reliability.

3.7 Data Collection

[71], state that data collection is a process whose aim is either to agree or disagree with some facts. The questionnaires will be self-administered by the researcher upon getting university authority to collect data and research. After being granted permission by the authorities of various institutions, questionnaires will be personally administered by the researcher by making arrangements by the various school principals. The researcher will administer the questionnaires during break time, lunch time and after afternoon lessons

to avoid interfering with students' class hours. On the day of delivery, the researcher will introduce himself to the respondents and also explain the objective of the study. The respondents will fill the questionnaires in the presence of the researcher to ensure that none of the questionnaires is left behind. The researcher will conduct interview schedules for principals from their offices individually.

3.11 Data Analysis Procedures

Data analysis is the process of bringing order, structure and meaning to the mass of collected information [70]. Once data is collected, it will be post-coded and analyzed using descriptive statistics with the help of the Statistical Package for Social Sciences (SPSS) software. Quantitative data gathered from closed ended questions will be coded first and organized into similar themes as per the research questions. It will be analyzed, tabulated and presented using by use of frequency tables and percentages.

Multiple linear regressions was used to test the research hypothesis. This is a technique of estimating a model consisting more than one predictor's predicted variable. The four usability dimensions are the predictors of user satisfaction. The multiple linear regressions have assumptions that must be met before adopting its result that is: the normality, linearity, heteroscedasticity and the multicollinearity assumptions.

The normality and heteroscedasticity assumptions are tested using residual analysis in the graphical approach procedure. A plot of a histogram of residual is used to assess normality assumption. A bell-shaped curve of regression residuals demonstrate normality. The heteroscedastic assumption (the variance of the errors across all levels of the DV should be constant) is assessed using the plot of residual versus fitted values. The assumption is met when the scatter plot points shows no apparent pattern, but a random pattern. If the normality and constant variance (heteroscedasticity) are met, then the

linearity assumption is met as well. The VIF factor is used to assess the multicollinearity issues (this is a situation when the Independent variables in the model are highly correlated' $r > 0.7$). VIF factors should be at most 10 but in strict sense, 5. This study tested for these assumptions.

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

In this chapter, the results of the analysis of the data are presented. The descriptive results of the respondents are presented so as to understand the study population. Reliability and validity tests are presented to assess the quality of the research. The correlation and regression analysis results are used for the test of hypothesis.

4.2 Response Rate

A total of 228 were sent to the field for data collection exercise and in table 4.1 summarizes the response rate of the same.

Table 4.1 Response rate

Category of Respondents	Target Responses	Returned	Response Rate
students	228	199	87.28
Total	228	199	87.28

Table 4.1 indicates that a total of 228 questionnaires were issued to the respondents to fill and return to the researcher. Of the total questionnaires, 199 were fully filled and returned representing 87.28% percent were collected for data analysis According to [73] a response rate of 50 percent and above is deemed to be sufficient for data analysis. Therefore, an average of 78.28% response rate was considered excellent for this analysis.

4.3 Demographic Information

The study ascertained the demographic information of the respondents and the then analyzed the substantive issues raised from the study objectives before doing factor analysis to establish the relations between and among variable.

4.3.1 Age of the respondents

As a preliminary issue, the study wanted to establish the age of the respondents and their responses were as in figure 4.1.

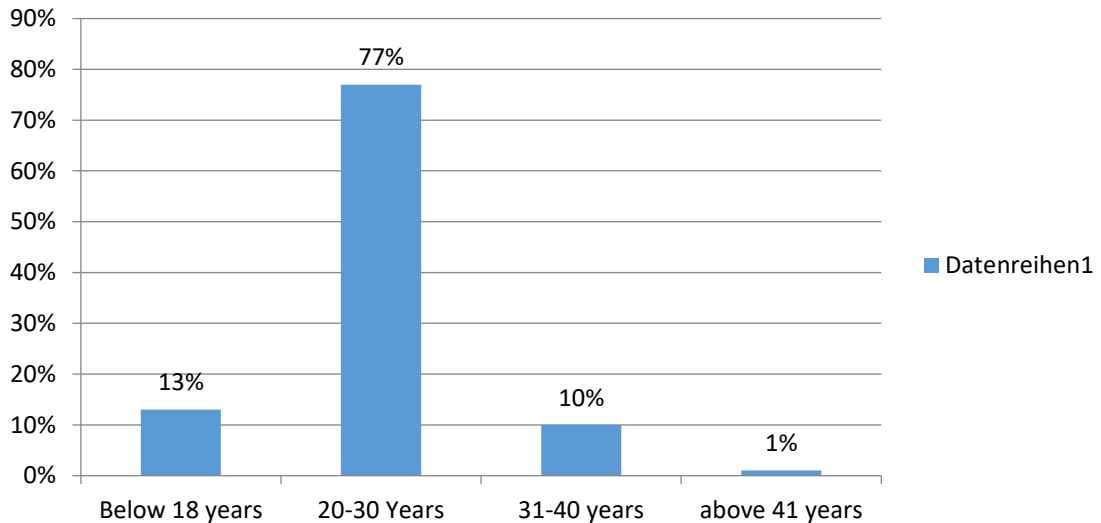


Figure 4.1 Respondents age

Figure 4.1 observed that majority of the respondents were between the age brackets, 20-30 year with a representation of 77%. It was further established that 135 of the respondents were b18 years while 10% and 1% of the respondents were 31-40 and above 41 years respectively. The results are significant as it indicates that the data collected and the information generated from it not is biased to a particular gender perspective given the ration of male to female is about equal.

4.3.2 Gender of the Respondents

The respondents were asked to indicate their gender and figure 4.2 records their responses.

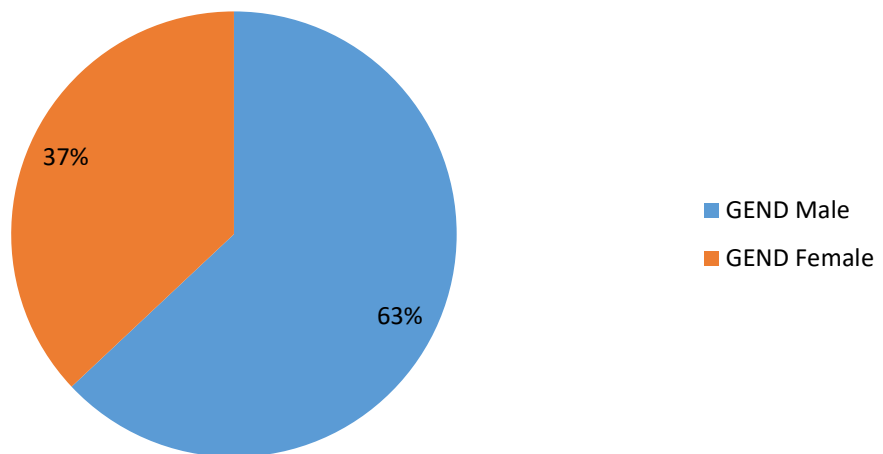


Figure 4.2 Gender of the Respondents

It was observed that majority of the responses were male being 63% of the total respondents and 37% were female. This was a good spread of the gender mix giving the analyses confidence devoid of a thinking of a particular gender.

4.3.3 Study Mode

The study wanted to establish the study mode used by the respondents in their institutions and figure

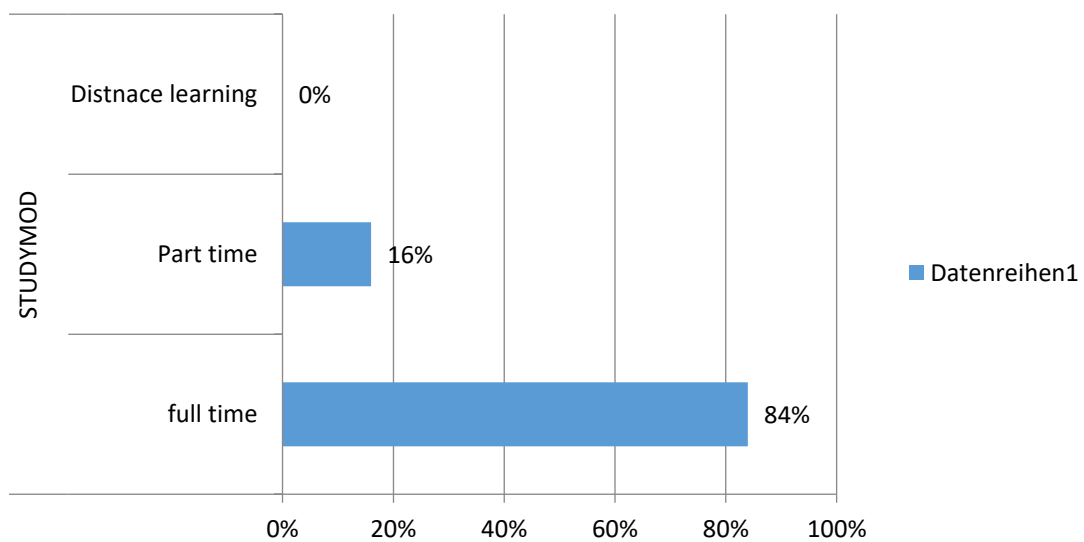


Figure 4.3 Study Mode

4.3.4 Study Learning System

The study wanted to find out the study learning mode of the respondents and figure 4.4 shows their responses.

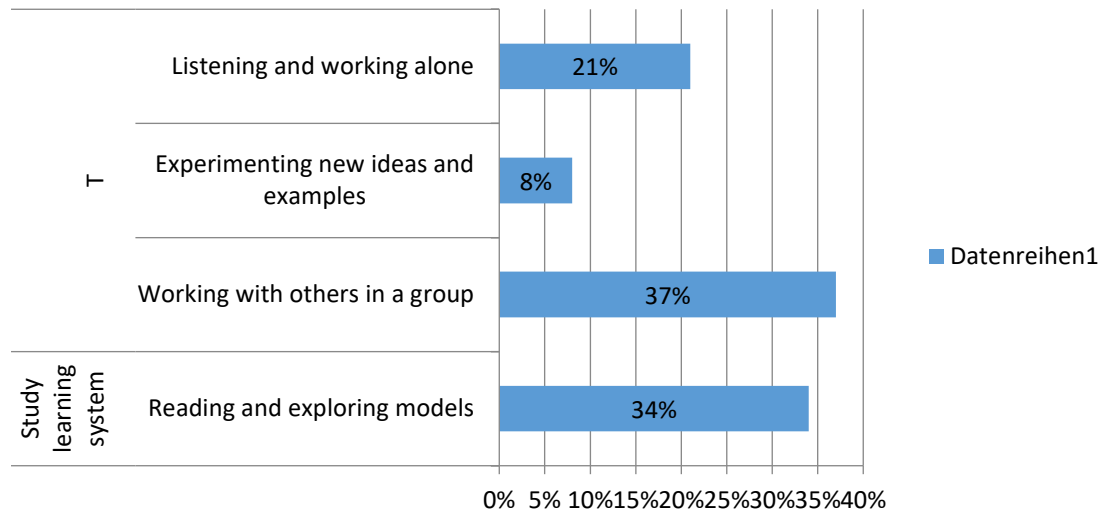


Figure 4.4 Study Learning Mode

From figure it was observed that majority of the responses 37% worked with others in groups, 34% in the reading and exploring models category, listening and working alone 21% and experimenting new ideas and examples at 8%. This was evidence that the responses were well spread out on different learning system and therefore reduces on the biases of opinions otherwise given by the same group

4.4 Descriptive Results of Main Study Variables

It is vital to explain how the mean values were interpreted throughout this study. The Mean values close to the high end of the scale (closer to 5) indicate high level and in contrast, while the mean values close to the lower end of the scale (1) indicate low level of the values. This interpretation is used throughout this study. In addition to the use of the mean to gauge the level of each item, the corresponding standard deviation of each item is also reported to evaluate the level of variation (agreement or disagreement) regarding each variable from the respondents.

The respondents were subjected to the key issues in the study variables to interrogate their effect on the user satisfaction. Table 4.2 captured the weighted mean and standard deviations.

Table 4.2: Descriptive Results of the Respondents

Variable	Mean	Std.	Skewness	Std.	Kurtosis	Std.
	Statistic	Deviation				
Efficiency	2.26	1.432	.792	.172	-.867	.343
Response Time	2.21	1.297	.891	.172	-.437	.343
Memorability	2.39	1.362	.653	.172	-.984	.343
Learnability	2.24	1.129	.619	.172	-1.025	.343
Satisfaction	2.43	1.383	.355	.172	-1.488	.343

Findings from table 4.2 indicated that overall, efficiency; response time, memorability and learnability are generally below average with memorability being the only variable above average with a mean of 2.39 (SD=1.362). System efficiency had a mean of 2.26 (SD=1.432); learnability had a mean of 2.24 (SD=1.362) and response time 2.26 (SD=1.432). The dependent variables user satisfaction attracted a mean of 2.43 (SD=1.3.83). These results draw indication of how usability of mobile learning system are performing when measured against user satisfaction. The study findings have established an average satisfaction implying that the university ought to do a lot to improve in usability characteristics.

4.5 Factor Analysis

Factor Analysis was on the data collected from to assess the structure of the items. The KMO and Barttlets test results indicated that the data is suitable for FA. The KMO is 0.66 which is well in the recommended range of at least 0.6. [74]. the Barttlet's Chi square is significant (P<.05) as required.

Table 4.3 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.866
Bartlett's Test of Sphericity	Approx. Chi-Square	9920.527
	df	378
	Sig.	.000

The principal Component for identifying the factor structure and a varimax rotation applied to clarify the structure. Only factors that recorded values of at least one were extracted. Also only items with loadings greater than 0.6 were retained in each factor. These restrictions ensure construct validity.

All the data on the study variable were subjected to FA. The factor structure results (figure 4.6) present a clear indication that the data constitutes a five factor structure (factors); the data separated out into five distinct constructs. The separating out of items designed to measure the study variables, for example, level of efficiency variable, clung together. Clustering together of items in FA is a positive evidence towards construct validity concerns which study should demonstrate.

In FA, the magnitude of factor loading is an indicator of strength of relation between the manifest items to its latent construct; higher is better. In this study, only items with strong loading (> 0.6) are retained so as to enhance Construct Reliability (Tentama & Anindita, 2020). Therefore the extracted constructs/factors are reliable constructs.

The System Efficiency (SSEFF) construct remained with only 4 items with loadings ranging from 0.81 to .845. The construct System Response Time, SSRT, has six items with strong loadings that range from 0.0.742 to 0.847. The construct, System Memorability (SSMO), comprise of five items with strong loadings ranging from 0.789 to 0.872. Finally, the satisfaction construct has four strong loading items (0.770 to 0.874).

Reliability of the five constructs was assessed using the Cronbach's alpha. It is demonstrated when the coefficient is greater than 0.7. Values obtained of the reliability coefficient range from 0.81 for System memorability to 0.942 for satisfaction.

The items in each construct were averaged and used to represent the underlying latent construct. For example, the four system efficiency constructs were averaged to obtain the system efficiency construct for descriptive and inferential analysis.

Table 4.4 FA Latent Constructs averaging

Factor (Reliability)	Loadings	
Efficiency& Effectiveness .842	SSEFF1	
	SSEFF2	.833
	SSEFF4	.845
	SSEFF5	.823
	SSEFF6	.812
Routine .840	SSRT1	.847
	SSRT2	.810
	SSRT3	.818
	SSRT4	.815
	SSRT5	.799
	SSRT6	.742
Learnability	SSLERN2	.890
	SSYLEARN3	.814
	SSLEARN4	.812
	SSLEARN5	.763
	SSLEARN6	.759
	SSLEARN7	.702
Satisfaction .942	SATSF1	.810
	SATSF2	.874
	SATSF3	.773
	SATSF4	.770
Memorability .812	SSMO1	.872
	SSMO2	.855
	SSMO3	.854
	SSMO4	.832
	SSMO5	.789

The descriptive results of the five constructs extracted from the FA are shown in table

Table 4.5: Descriptive based values

Variable	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Efficiency	2.26	1.432	.792	.172	-.867	.343
Response	2.21	1.297	.891	.172	-.437	.343
Memorability	2.39	1.362	.653	.172	-.984	.343
Learnability	2.24	1.129	.619	.172	-1.025	.343
Satisfaction	2.43	1.383	.355	.172	-1.488	.343

4.6 Correlation Results

The association between the study variables was investigated to determine the level and nature of correlation between the independent variables and the dependent variable. The results are presented. The correlation coefficients between the independent variables and the DV all have the expected positive sign, meaning that when the students have a positive perception of the system being (efficient, effective, memorable and learnable) the probability of user satisfaction is also high. In particular, the results suggests that users who view a system as efficient for learning, are more likely to be satisfied than the ones with that view a system as inefficient. Moreover, the correlations are all statistically significant since the associated p values are all less than the 0.05 significant levels. This means that the observed association is not a chance association. The significant independent variables are all candidates in the multivariate regression analysis to determine the joint influence of the each independent variables on DV.

Table 4.6: Correctional analysis

Correlations		V1	V2	V3	V4	V5
Efficiency V1	Pearson Correlation	1	**			
	Sig. (2-tailed)					
Response Time	Pearson Correlation	.444**	1			
	Sig. (2-tailed)	.000				

Memorability V3	Pearson Correlation	.612**	.368**	1		
	Sig. (2-tailed)	.000	.000		1	
Learnability V4	Pearson Correlation	.468**	.268**	.504**		
	Sig. (2-tailed)	.000	.000	.000		
Satisfaction V5	Pearson Correlation	.677**	.390**	.22**	.670**	1
	Sig. (2-tailed)	.000	.000	.000	.000	

In relative terms, the association between satisfaction and usability dimensions indicate of system Efficiency & effectiveness (i.e. usefulness and ease of use) is the strongest association ($r=.677$). This is followed by Learnability ($r=.640$) and least is memorability. The results suggest that different dimensions of System Usability have different enhancing effect on user satisfaction. These further points to system developers and maintenance on areas of prioritization and allocation of resources.

4.7 Regression Analysis

4.7.1 Assumptions

The normality assumption was tested using graphical approach. A histogram of residuals shows that the distribution conforms to a normal distribution (figure 4.6). The Quartile-quartile plot conforms to the normality plot thus further confirming that the assumption is met. This is important going forward; the findings of the study can be reliably generalized to larger population.

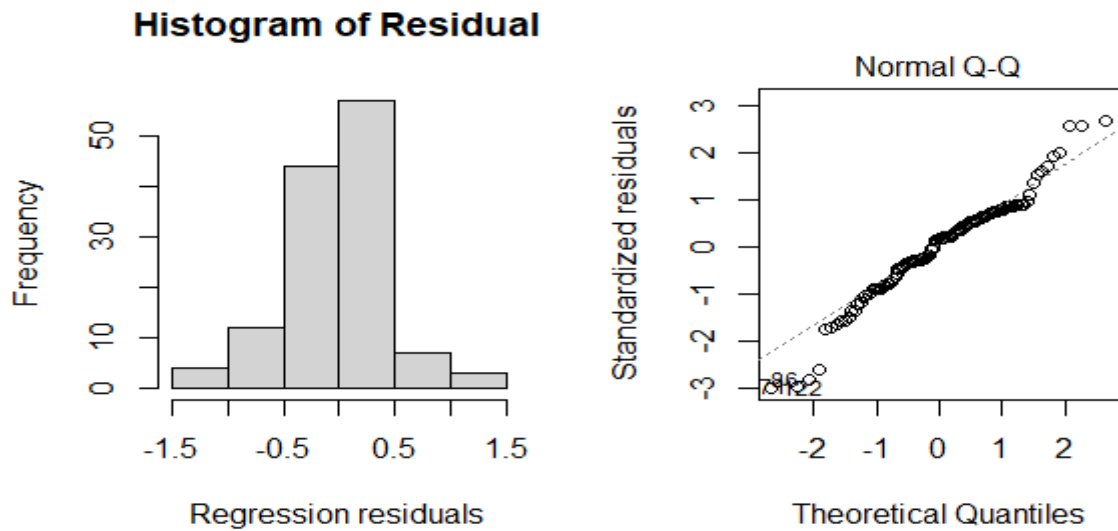


Figure 4.6 Histogram residues and normal Q-Q

The other assumption of no heteroscedasticity (variance of the errors around the regression surface is everywhere the same) is also assessed using graphical approach. A plot of regression residuals against the predicted values is used to check for this assumption. The assumption is met when no pattern emerges and therefore the plot points randomly displayed out. This condition is met as shown in figure 4.6.

The positive test for normality and no heterosexuality assumptions confirms the assumptions of linearity assumption. This is confirmed further by noting that the even distribution of the errors below and above the regression line ($y=0$) of the figure 4.7. This means for predicting user satisfaction from system usability, the linear model is the best fit for the available data. The plot of residuals versus predicted values for no heterosacdastic assumption

Figure

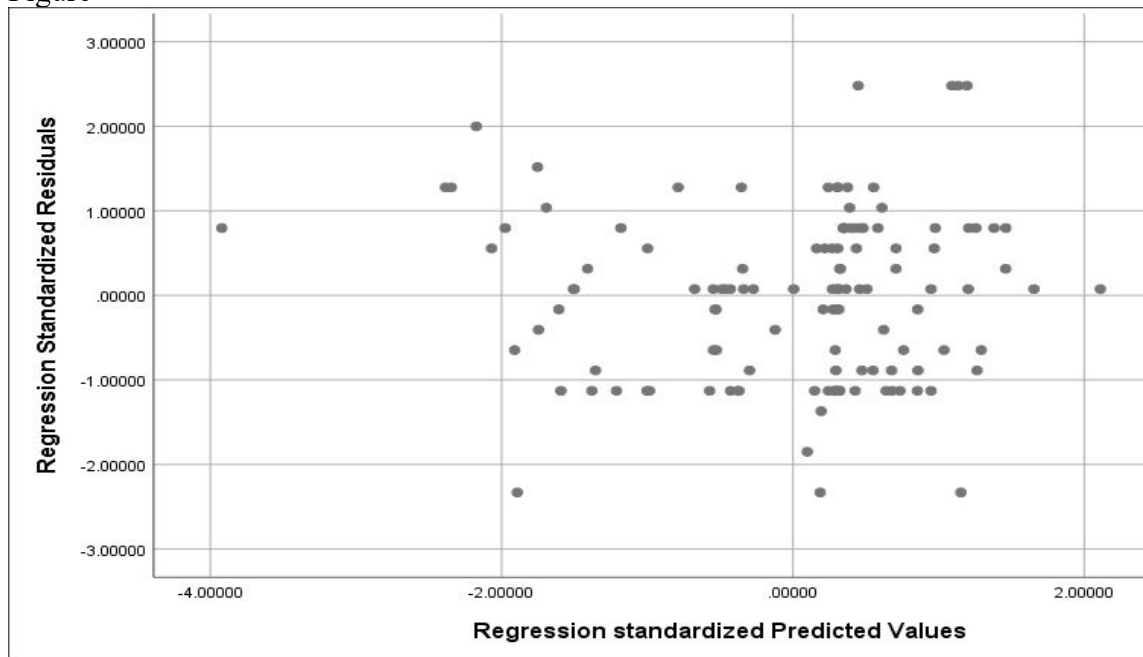


Figure 4.7: Regression standardized predicted values

Fitting an appropriate model to the data is one of the strengths of a study in modeling. Meeting the model assumptions is important towards this goal.

4.7.2 Regression Results

The four IVs were regressed on the DV so as to enable the research conclude on the influence of each of the system usability attributes on user satisfaction.

Table 4.7: KMO and Bartlett's Test

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.800 ^a	.640	.632	.869

Regression analysis produces model estimates and model adequacy statistics. The R square provides the goodness of the model as it shows the amount of variability in the DV accounted for the model predictors. Based on the findings, the model accounts for 64.0 percent of variance in the satisfaction (R square=.640). When adjusted for the

number of predictors, the model accounts for 63.2 percent of satisfaction (R square=.632, adjusted). The results are significant given that it accounts for more than 60 percent, yet there are possibly more satisfaction enablers.

Table 4.8: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	258.673	4	64.668	85.680	.000 ^b
Residual	145.670	193	.755		
Total	404.343	197			

The ANOVA results are also a model adequacy test researchers use to evaluate the overall fitness, or the significance of the regression slope, of regression function. The ANOVA results in Table 4.7 two shows that the model slope is significance different from zero (F (4,193)=85.680, p<.001). The results are indication that the variability in the 4 system usability attributes can explain to a significance extent the satisfaction levels observed among the system users.

4.7.3 Regression coefficient table

The regression coefficient table provides the detail influence of each system usability attributes on user satisfaction.

Table 4.9: Regression coefficient

	B	Std. Error	t	P
(Constant)	4.084	.579	7.054	.000
Efficiency & Effectiveness V1	.377	.059	6.392	.000
Response Time2	.079	.063	1.250	.213
Memorability V3	.325	.108	3.009	.003
Learnability V4	.420	.108	3.895	.000

Table 4.9 indicates that system efficiency has a significant influence on user satisfaction ($B=0.377$, $p<.001$). The hypothesis **H₀₁** is rejected at 5% significant level. System Efficiency, a component of system usability is therefore a significant determinant of user satisfaction that should not be ignored.

The average response time a system takes has positive but non-significance influence on user satisfaction ($B=.079$, $p=.213>.0$) that system efficiency improvement is at the core of user sanctification. No sufficient evidence, at 0.05 significance level to reject the hypothesis H₀₂. However, the memorability of the system has a significance positive influence on user satisfaction ($B=.325$, $p=.003<.05$). The hypothesis H₀₃ is thus rejected at 0.05 level of significance. Finally, the study discovered that user satisfaction is influenced by learnability to a significant extent ($B=.420$, $p<.001$). Overall, the regression results have shown that usability of a system is a significant predictor of level of user satisfaction. The user satisfaction is important at universities and can be improved, by among other things, improved usability of the learning system. Highly usable products are advantageous especially in a learning institution; reduced costs of use, higher sales, and higher user loyalty than unusable products.

One of the things that keeps organizations including universities in Nakuru County survives in a competitive business environment is because of their customer's satisfaction. And they should take good care of it because if not, it will deteriorate their customer service, their product, and most importantly, the life of their business.

Finally, examining the relative magnitude of our regression coefficients results in Table 4.9, important information is derived for the system developers and maintainers. Of the four usability dimensions, System Learnability has the strongest influence on satisfaction ($B=.420$), followed by Efficiency & Effectiveness (usefulness and ease of use. $B=.377$).

But response time is the least is the least. The results specifies the areas of the model for prioritization and resource allocation

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1 Introduction

The chapter highlights the summary of the study findings and the discussions emanating from the findings based on the study objectives.

5.2 Results on Effectiveness of Usability learning System

This study discusses the relevant and appropriate usability dimensions and measurements for mobile learning applications for and how they influence user satisfaction using the university students as the study sample. The study sought to evaluate the effectiveness of mobile learning system and user satisfaction; the motivation of the study was to find out whether the usability of the current system by the Universities in Nakuru County enhances the student satisfaction with a view that this satisfaction is important in the university's competitiveness. The research concerns therefore were assessed on system efficiency, time on response, memorability of the system, and learnability of the system. Universities in Nakuru County are majorly the institutions in Kenya that adopted the online technologies. However, there are many complaints from the users, the students, on many inefficiencies coming along with the online learning platform. To what extent is the satisfaction level of the current learners is explained by system usability? The findings of this study contradict those of [24] that to what extent is the satisfaction level of the current learners is explained by system usability. Findings of this study confirmed the outcomes of the research tool mentioned before, meaning that data was collected from key respondents; the students. The study found a significant positive association between system usability attributes and learner satisfaction. This revelation informs the university that high level of system usability scores are necessary in enhancing competitiveness and customer loyalty through its increased probability of customer satisfaction.

5.2.1 System Efficiency on Effectiveness of Mobile Learning System User Satisfaction

In particular, the efficiency and satisfaction were found to be significantly correlated to the university at a time the universities are struggling with financial challenges. It is clear to the universities that when their students harbor the views that the institution learning system is efficient their satisfaction level is equally high hence, important to enhance university's competitiveness.

Efficiency and satisfaction's regression results revealed that system efficiency supported user satisfaction. This result specifies that individual students will derive much satisfaction of the system if they perceive the using of the learning system as efficient. Here the study report evidence for the importance of the efficiency of learning system in determining students' satisfaction. Studies by [24] indicate that information quality, system quality, and service quality have a positive effect on user satisfaction, and the subsequent user satisfaction has a positive effect on net benefits. The study also agrees with studies [34] which established that without understanding the critical features, the implementation of the most innovative and recent technologies are pointless. Rather than having any academic reach, such implementation may just be a promotional exercise. Further there is consistency that because of the variations in certain areas between conventional learning and e-learning, there is a need for efficient and productive transfer of conventional programs to e-learning [33]. The shift may involve a complicated undertaking that involves adequate preparation, tracking, and supervision. Besides, the consistently increasing worldwide demand for e-learning has prompted the adoption of web-based environments; however, these need to be first evaluated based on their performance [34]. The success of e-learning education depends highly on WLMS implementation and its adaptation by the end-users [8].

5.2.2 System Response Time on Effectiveness of Mobile Learning System User Satisfaction

From the study finding on the second objective which sought to establish the relationship between system response time and user satisfaction showed a non-significant effect on user satisfaction. The result specifies that improving on system response time; the user satisfaction may not be improved as well. If the system response time is slow and users have to cool their heels for several seconds, it can impact their perceived usage experience and satisfaction. These finding agrees with [37] Proposed the ideal response time to be around two seconds. He also speculated, purely by observational means, that a user could detect a change of $\pm 8\%$ in the 2-4 second response time category.

The study therefore concludes that there is a positive and significant relationship between system response time and user satisfaction among the university students under study. The findings were found consistent with studies by [35] in china which demonstrated that response time not only adversely affects user experience of mobile applications, but that this effect is not homogeneous across the three dimensions of tolerance, acceptance and satisfaction. This study showed that indeed satisfaction does decrease as response time increases. It also showed that that for discretionary browser-based applications, there appears to be a level of intolerance in the 12-second response range. This was also agreement in the study findings as studies by [36] on user perception of computer system response time and suggested that a model of user perception is central to the design effort. In tandem to the findings too were studies by [37] who proposed the ideal response time to be around two seconds.

5.2.3 System Memorability on Effectiveness of Mobile Learning System User

Satisfaction

Further, satisfaction of learners Universities in Nakuru County are influenced by memorability of system. These findings clarify that learners will derive much satisfaction when they are able to easily re-establish proficiency after a period of not using the system. These findings are empirical evidence for the university to consider having a system that is designed with memorability attributes well considered. These findings were similar to results of a study by [22] who found a strong relationship between system usability, and user memorability of the contents of a system to abate interaction errors which provides for an effective and efficient learning environment found that memorability influence user intention to reuse a system and satisfaction. The study findings are also in concurrence with studies by [40] who found that system usability, impacts on user's satisfaction, learnability and memorability of the contents of a system to abate interaction errors which provides for an effective and efficient learning environment and that as the field of mobile Learning innovations advances by leaps and bounds, the ultimate success of the learning pedagogy relies upon the human factors exhibited whilst using mobile and wireless technologies [42]. Further, the use of mobile learning is very useful, there are minimum students adopt mobile learning despite the increasing use of mobile devices [43]. The study also agrees with findings by [44] who analyzed the impact of Mobile Learning the relationship between various factors from the perceived usefulness and found a perceived ease of use of such attitudes and behavior intention to, in order to explain user's acceptance of new technologies and how these factors role, so as to provide theoretical support and technical services for effectively promote and facilitate Mobile Learning. Therefore, based on the above analysis on the technology acceptance model, Perceived usefulness, Perceived ease of use and External variables can make a very

important influence for the user to receive and adopt new technologies [45]. It has been found in the literature that mobile-learning context is not necessarily similar to other IS, and therefore the unified theory of acceptance and use of technology core constructs may not be sufficient in determining a user's behavioral intention [45].

5.2.4 System Learnability on Effectiveness of Mobile Learning System User

Satisfaction

Finally, learnability of the system-the ease of learning new functionalities, supported user satisfaction. These results clarify those learners who perceive the system as easy to learn will have higher satisfaction and by extension develop stronger loyalty to the system as well as the university. It is vital that users can pick up how to use an application quickly. If you are creating software for professional use, this can be especially important, as employers are less likely to spend money on software that requires expensive training for staff members. The study recommends that the developers should optimize learnability by creating simple user interface designs that are predictable in layout and navigation. They should endeavor to improve learnability by finding out what the expectations of the users are before they use the application. This can be achieved through a focus group or through requirements engineering. The developers should carry out usability testing to discover how quickly end users pick up how to use the application. If the usability test is carried out several times with the same user at different intervals, you can also see how memorable the application was. Feedback can then be used to optimize the learnability of an application, increasing its chances of success on the market.

The study is in agreement with studies by [51] who measured learnability in terms of visibility of operation; feedback; continuity of task sequences; design conventions; information presentation; user assistance; error prevention, Conformity of user's

expectations: differences in functionality and hence established a correlation between system usability and learnability attributes. The study is in agreement by finding of [52] who found a relationship between system usability and learnability for child and adult users. However, the study was different from studies by [54], who found a negative relationship mobile devices have much potential to support older adults in their daily lives. However older adults have reported that they find mobile devices, such as existing mobile phones, difficult to learn to use have also found a positive influence of learnability on satisfaction in considering the previous studies and the current findings, it is evident that the learnability is critical for universities learning system. The main aim of effectiveness evaluation is to investigate possible problems of a system and discover ways to resolve those problems. Usability analysis is an important step in software development in order to improve certain aspects of the system [55]. However, it is often a challenge especially when it comes to evaluating applications running on mobile devices because of the restrictions posed by the device and the lack of supporting tools and software available to collect the necessary usability data [29]. According to [56] in usability evaluation framework of mobile application aims to identify the main issues in the user interface that may lead to human error, terminate the user interaction with the mobile application and cause user frustration.

[57] indicated in their study that children between the ages of 8 and about 14 years require engageability to improve their learning to use of a new application software this being an important factor in their learnability, this is not to mean that other users of a different age do not require this principle but the degree to which it affects them is different. As for the older kids (15 to 19 years), the findings indicated that they strongly require discoverability to improve their learnability of new application software, this is not to

mean that adults or children of different ages do not require this given principle but to say the degree to which varies.

5.3 Implications of the Result

The purpose of creating a mobile application is to meet the information needs of the focus users on the application. The extent to which the mobile applications designed for this purpose are used by the users and the levels of the information they provide are reached by the evaluation of qualitative and quantitative data. In this study, effectiveness of usability on mobile learning systems for user satisfaction at Universities, in Nakuru County was investigated. From the study findings, the study implications are as follows:

5.3.1 Efficiency on Mobile Learning System User Satisfaction

Efficiency and satisfaction's regression results revealed that system efficiency supported user satisfaction. This result specifies that individual students will derive much satisfaction of the system if they perceive the using of the learning system as efficient. The study therefore concludes that there is a positive and significant relationship between system efficiency and user satisfaction.

5.3.2 System response Time on Mobile Learning System User Satisfaction

From the study empirical findings, system response time showed non-significant effect on user satisfaction. The result specifies that improving on system response time; the user satisfaction may not be improved as well. If the system response time is slow and users have to cool their heels for several seconds, it can impact their perceived usage experience and satisfaction. The study differs with findings by [75] who in their investigation of System response time and user satisfaction found system response time influences user satisfaction. Lengthy system response times may cause lower satisfaction

and poor productivity among users. Lowered user satisfaction may lead to learners jetting out to other universities, especially for the parallel or self-sponsored students, and these are the great sources of financing.

5.3.3 System Memorability on Mobile Learning System User Satisfaction

The third objective sought to establish the relationship between the system memorability and user satisfaction among the university students in the study area. Information generated from the study shows that satisfaction of learners in Universities in Nakuru County are influenced by memorability of system. The results observed that the general mean of the memorability index was below average with a mean of 2.39 (SD=1.362). This indicated to a low degree of user satisfaction among the targeted respondents of the university. However correction studies recorded a statistically positive relationship between the memorability and user satisfaction. This implied that, if the university implemented effective system memorability, user satisfaction will improve.

These findings clarify that learners will derive much satisfaction when they are able to easily re-establish proficiency after a period of not using the system. The study therefore concludes that there is a positive and significant relationship between system memorability and user satisfaction in the study area.

5.3.4 System Learnability on Mobile Learning System User Satisfaction

The last objective of this study looked into the effect learnability attributes of the system deployed by the university. The study observed that the learnability index was below average with a mean of [2.24 (SD=1.3620)]. Despite of the low user satisfaction due to learnability attributes of the system, correlation analysis observed a statistically positive relationships between system learnability and user satisfaction. This implied that, with improved system learnability, there was an expected user satisfaction attribute from the

system users, the students. These results from the study findings indicates that the respondents who perceive the system as easy to learn will have higher satisfaction and by extension develop stronger loyalty to the system as well as the university. Hence, the study concludes that there is a significant and positive relationship between system learnability and mobile learning system user satisfaction.

The dependent variables user satisfaction attracted a mean of 2.43 (SD=1.3.83). These results draw indication of how usability of mobile learning system is performing when measured against user satisfaction. The study findings have established an average satisfaction implying that the university ought to do a lot to improve in usability characteristics. Generally, the study found a significant positive association between system usability attributes and learner satisfaction. This is revelation informs the university that high level of system usability scores are necessary in enhancing competitiveness and customer loyalty through its increased probability of customer satisfaction.

CHAPTER SIX

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This section presents the summary of the study findings, conclusions emanating from the findings and the recommendations based on the study objectives.

6.2 Summary of Chapters

This section presents summary of the chapters in this thesis. Chapter one laid down the foundation of the study by looking at the background information to the study and identifying the problem area. It presented the study objectives and the significance of the study. Chapter two presented an analytical analysis of previous literature in the study area and the conceptual framework of the study. Chapter three presented the methodology that was followed to achieve study objectives while chapter four presented the data obtained in the study and the analysis of the data. And in chapter five deals with the discussion of the meaning, importance and relevance of the results. This chapter presents the summary of findings, conclusions drawn from the findings and recommends areas for further research.

6.3 Summary of Findings

The purpose of this study was to evaluate the effectiveness of usability learning models on user satisfaction in universities in Nakuru County, Kenya. The motivation of the study was to find out whether the usability learning models of the current system by the Universities in Nakuru County enhances the student satisfaction with a view that this satisfaction is important in the university's competitiveness. The summary of the findings are presented in line with the objectives of the study.

6.3.1 System Efficiency

In particular, the efficiency and satisfaction were found to be significantly correlated to the university at a time the universities are struggling with financial challenges. It is clear

to the universities that when their students harbor the views that the institution learning system is efficient their satisfaction level is equally high hence, important to enhance university's competitiveness. Regression results, which are the core of this study, revealed critical findings on each research objectives.

Efficiency and satisfaction's regression results revealed that system efficiency supported user satisfaction. This result specifies that individual students will derive much satisfaction of the system if they perceive the using of the learning system as efficient.

6.3.2 System Response Time

From the study empirical findings, system response time showed non-significant effect on user satisfaction. The result specifies that improving on system response time; the user satisfaction may not be improved as well. If the system response time is slow and users have to cool their heels for several seconds, it can impact their perceived usage experience and satisfaction.

6.3.3 System Memorability

Further, satisfaction of learners in Universities in Nakuru County is influenced by memorability of system. These findings clarify that learners will derive much satisfaction when they are able to easily re-establish proficiency after a period of not using the system.

User memorability of the contents of a system to abate interaction errors which provides for an effective and efficient learning environment found that memorability influence user intention to reuse a system and satisfaction. These findings are empirical evidence for the university to consider having a system that is designed with memorability attributes well considered.

6.3.4 System Learnability

Finally, learnability of the system-the ease of learning new functionalities, supported user satisfaction. These results clarify those learners who perceive the system as easy to learn will have higher satisfaction and by extension develop stronger loyalty to the system as well as the university. It is vital that users can pick up how to use an application quickly. If you are creating software for professional use, this can be especially important, as employers are less likely to spend money on software that requires expensive training for staff members. The study recommends that the developers should optimize learnability by creating simple user interface designs that are predictable in layout and navigation. They should endeavor to improve learnability by finding out what the expectations of the users are before they use the application. This can be achieved through a focus group or through requirements engineering. The developers should carry out usability testing to discover how quickly end users pick up how to use the application. If the usability test is carried out several times with the same user at different intervals, you can also see how memorable the application was. Feedback can then be used to optimize the learnability of an application, increasing its chances of success on the market.

6.4 Conclusions

From the study findings, usability dimension is believed to be the important guideline for developers to ensure that users perform tasks in convenient ways. This research has presented selected usability dimensions which play vital roles in evaluating the effectiveness of mobile learning applications for students. The purpose of creating a mobile application therefore is to meet the information needs of the focus users on the application. The extent to which the mobile applications designed for this purpose are used by the users and the levels of the information they provide are reached by the

evaluation of qualitative and quantitative data. In this study, evaluation of usability models on mobile learning for user satisfaction at Universities in Nakuru County, in Kenya was investigated. From the study findings, the study wishes to conclude as follows:

6.4.1 Efficiency on Mobile Learning System User Satisfaction

Efficiency and satisfaction's regression results revealed that system efficiency supported user satisfaction. This result specifies that individual students will derive much satisfaction of the system if they perceive the using of the learning system as efficient. The study therefore concludes that there is a positive and significant relationship between system efficiency and user satisfaction

6.4.2 System response Time on Mobile Learning System User Satisfaction

From the study finding on the second objective which sought to establish the relationship between system response time and user satisfaction showed a non-significant effect on user satisfaction. The result specifies that improving on system response time; the user satisfaction may not be improved as well. If the system response time is slow and users have to cool their heels for several seconds, it can impact their perceived usage experience and satisfaction. The study therefore concludes that there is a positive and significant relationship between system response time and user satisfaction among the university students under study.

6.4.3 System Memorability on Mobile Learning System User Satisfaction

The third objective sought to establish the relationship between the system memorability and user satisfaction among the university students in the study area. Information generated from the study shows that satisfaction of learners in Universities in Nakuru

County is influenced by memorability of system. These findings clarify that learners will derive much satisfaction when they are able to easily re-establish proficiency after a period of not using the system. The study therefore concludes that there is a positive and significant relationship between system memorability and user satisfaction in the study area.

The study recommends that given the kind of empirical evidence from the university to consider having a system that is designed with memorability attributes to be considered for the clients to come back to the website from time to time hence improved user satisfaction.

6.4.4 System Learnability on Mobile Learning System User Satisfaction

The last objective sought to establish the relationship between system learnability and mobile learning system user satisfaction. These results from the study findings indicates that the respondents who perceive the system as easy to learn will have higher satisfaction and by extension develop stronger loyalty to the system as well as the university. Hence, the study concludes that there is a significant and positive relationship between system learnability and mobile learning system user satisfaction. Overall, the study findings the study concludes that there is a positive and significant relationship between the study variables, that is, system efficiency, system response time, system memorability and system learnability on mobile learning system user satisfaction at Universities in Nakuru County, in Kenya.

Overall, the study concludes that it is of essence to meet usability needs of those applications in terms of satisfying the needs of end-users since user interface plays the most important role for each individual's interaction between the user and his/her

smartphone application. Thus, mobile applications must be easy to use, learnable, understandable, and attractive as well as providing an enjoyable experience for users.

6.5 Recommendations

The findings have unearthed the critical role of system usability as one of the tools the university can use to create a competitive advantage as well save them from financial distress. This information should redefine the universities' modus operandi in ways that system usability is becomes the nerve Centre of its growth policies. The university should now henceforth carry out regular in-depth research, especially qualitative research, to understand the whole set of underlying factors. This will help the university understand why the students' satisfaction level is where it is and how the satisfaction level can be raised and maintained. And when this research culture is well integrated in the university's policies, the opinions expressed can help the university generate new ideas for research critical in creating competitive edge in information technology.

Again, the university staff in charge of system acquisition and maintenance now has the technical information on priority areas which should be used well for the good of the university. One of the ways the university makes use of this information is ensuring that other stakeholders (e.g. finance and administration) are well explained on the sensitive areas of the system usability and the impact it has on the overall competitiveness of the university. Again, with this information, it is imperative now that prioritization of the system learnability as well as system efficiency and effectiveness is the best option for the university. System problems and challenges will always arise, but those touching on these dimensions should be addressed as a matter of urgency to avoid problems escalating further like reduced revenues as a result of unattractiveness of the university's system.

6.5.1 Efficiency and user satisfaction

The university can achieve significant benefits as results of improved user satisfaction, but they have to ensure that the system is both efficient and effective (usefulness and easy to use). A number of studies have provided system strategies on how to improve efficiency and effectiveness. It includes training, allowing organizations to gather actionable feedback with intuitive reporting, admins can monitor employee performance and skill gaps among other strategies. If these strategies are well sustained through the university, the benefits accruing can transform the struggling universities, but it has financial implications that need to be brought into the delicate balance.

The study further recommends that the students complain on the efficiency of system ought to be addressed in a record time if the variance on user satisfaction has to be improved and sustained. To improve on the efficiency of the service delivery in terms of efficiency of the system, the universities should endeavor to outsource the service so as to bring about positive competition on service delivery hence, user satisfaction.

6.5.2 System response Time on Mobile Learning System User Satisfaction

The study recommends that the university management through there ICT division should work hard in ensuring that the system response time is enhanced as the more the response time the higher the response on user satisfaction. The study further recommends that to ensure system response time, unnecessary websites not related to educational practices in the universities should be censored to minimize on the idlers jamming the system hence, slowing down on the system.

According to the responses from the respondents, an easy and clear application should be designed, and system information and error messages should be clearly defined because the research shows that the quality of information and interface quality have

serious effects on user satisfaction. These criteria increase the satisfaction rates of the users and ensure that the application achieves its intended purposes.

From the study findings, the study recommends that software developers should pay attention to the task completion time of the interfaces as they significantly impacts on user satisfaction. The application developers should pay attention to ease of use and the processing of speed while developing their applications.

6.5.3 System Memorability and user Satisfaction

More benefits of user satisfaction can still be achieved if the memorability and learnability of the system is concurrently addressed with worked on. At this age of sophisticated gadgets with user friendly interface, the learning system the university uses should not be far from the other gadgets in terms of reuse and learning.

6.5.4 System Learnability and User Satisfaction

The system developers have to understand When the university is able to It should be It is conclusive that the University can turn around the persistent high rates of systems complaints and become attractive to students to the extent it is able to package the learning systems in ways that the learners perceive it as learnable. It entails the university, guided by ICT department, ensuring the system has the quality of products and interfaces that allows users to quickly become familiar with them and able to make good use of all their features and capabilities.

The importance of creating a high user system ecosystem for the university cannot be overemphasized especially at this time universities are facing financial crisis running to millions of shillings. Since a university with satisfied users has numerous positive financial and non-financial outcomes. The bargaining power is one of the advantages

universities with superior usable systems. Universities these educational centers can attract more learners and therefore more revenues through investment in the learning systems with superior system attributes. The universities can survive the challenges they undergo, usability is one of them if they have to increase their future prospects.

The first important contribution of this study is concentrated on investigating the influence of user' post-adoption usability on students' satisfaction in university setting. We hope this research can inspire the research community to move the research field forward to other organizations and users of old age. Again, it is the hope of this research that the empirical findings can provide a valuable reference to functional or utilitarian e-service practitioners especially in the field of education for making competitive strategy decisions to obtain customers' loyalty and thereby increase the firms' revenues. Success in Customer Satisfaction will continue be dividing line between failed from success organizations especially in the universities where alternative are abundant.

6.6 Suggestions for Further Research

The current study was based on the survey design relying only on quantitative data. It therefore suffers from the insights of qualitative methods. Therefore, future studies should incorporate both aspects of quantitative and qualitative data. Future studies should consider diverse sources of informants to enable the study strengthen its credibility through triangulation given that the current study only used Universities in Nakuru County department of ICT students as study respondents.

The data used for this study was cross sectional-collected at one particular time point. Studies with longitudinal design can be employed to capture faithfully the complex and dynamic interrelationship between usability experiences and continuous usage intention and satisfaction. This is important since the association between users' post-adoption

experience and continuous usage intention may be changed once the learning curve has been achieved and sufficient usage experience has been collected through frequent usage. Further, the instrument used to measure the users' perceptions toward system usability and satisfaction may be biased because the research subjects are confined to the current and continued users of the system, it does not include the discontinued users who may have important insights and experiences. Future research should consider this group.

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APPENDICES

APPENDIX A: QUESTIONNAIRES FOR LEARNERS

SECTION A: DEMOGRAPHIC INFORMATION

A1. a) Department.....

b) Institution.....

A2. Gender: Male Female

A3. Level of study: Certificate Diploma Degree Masters PhD

A4. Current year of study: 1ST 2ND 3RD 4TH 5TH

A5. Mode of Study: Full Time Part Time Distance Learning

A6. Age in years: Below 20 20 – 25 25 – 30 Above 30

SECTION B: MOBILE LEARNING SYSTEM AND INTERNET EFFICACY

B1. Have you used Internet on your own? Yes No

B2. For how long have you used the Internet?

Below 2 Years 2 – 4 Years 4 – 6 Years Above 6 Years

B3. Select the Mobile Learning Systems (MLS) you have used or you are currently using: Wiki Moodle WebTV Blackboard Any other specify.....

B4. For how long have you been using Mobile Learning System?

0 – 1 Years 1 – 2 Years 2 – 3 Years More than 3 years

B5. Select the statement(s) that best describe how you prefer learning?

I prefer reading, exploring analytical models, and having time to think things through

I prefer working with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project

[] I prefer experimenting new ideas, simulations, laboratory assignments and practical applications

[] I don't prefer to work in groups, listening with an open mind to different points of view and receiving personalized feedback

SECTION C: SYSTEM EFFECTIVENESS

Effectiveness is the ability of a user to complete a task in a specified context. Using the following scale, rate the extent to which you agree to the statements below. Key: **SD**-Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
C1	MLS makes possible personalized access to course contents.					
C2	MLS provides more flexible method of learning as it can be done anywhere.					
C3	Using MLS to read course materials can increase my learning effect.					
C4	MLS helps me to produce class assignments of higher quality					
C5	MLS cannot be used for learning due to expenses involved in mobile-learning.					

SECTION D: TIMELINESS /SYSTEM RESPONSE TIME

Timeliness is the degree to which user think a received message is time-sensitive or has immediate feedback. Using the following scale, rate the extent to which you agree to the statements below. Key: **SD**-Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
D1	When the instructor posts a message in MLS, I could receive this message immediately.					

D2	When my peer replies to my question in MLS, I could receive the replied message in appropriate time.					
D3	I can see the instant question and answer discussions among my teammates in MLS automatically					
D4	When I ask a question for instructor in MLS, I cannot receive the instructor's response in appropriate time.					
D5	Overall, I think that the messages in MLS are received immediately.					

SECTION E: SYSTEM EFFICIENCY

Efficiency is the ability of the user to complete their task with speed and accuracy. Using the following scale, rate the extent to which you agree to the statements below. Key: **SD** Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
E1	Course learning objectives (improving online information evaluation skills) can be met by MLS					
E2	Course structure in MLS is clearly visualized					
E3	MLS provides an impressive communication with other students					
E4	Vocabulary and terminology used in MLS are appropriate for student.					
E5	Downloading course content in MLS is slow.					

SECTION F: MEMORABILITY

Memorability is the ability of a user to retain how to use an application effectively. Using the following scale, rate the extent to which you agree to the statements below.

Key: **SD** Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
F1	I feel it is easy to remember how to use MLS					
F2	It is easy to reuse the options like (home, assignment, etc. button) in MLS in the next time.					
F3	The use of special signs in MLS buttons helped me to remember how to use application effectively					
F4	It is difficult for me to remember how to use the courseware in MLS.					
F5	I can use MLS more easily in future session.					

SECTION G: LEARNABILITY/ PERCEIVED EASE OF USE

This is the degree to which the MLS is easy to use to perform various pedagogic tasks and achieve course objectives. Using the following scale, rate the extent to which you agree to the statements below. Key: **SD**-Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
G1	I am confident of using system even if there is no one around to show me how to do it.					
G2	I am confident of using system even if I have never used such a system before					
G3	I am confident of using the system as long as I have a lot of time to complete the task to be done					
G4	I would find the user interface of the system clear and intuitive					
G5	Generally, I find the Mobile learning system to be easy to use.					

SECTION H: ARCHITECTURE OF MOBILE LEARNING SYSTEM

Architecture is the structure and organization of mobile learning system. Using the following scale, rate the extent to which you agree to the statements below.

Key: **SD**-Strongly Disagree, **D**-Disagree, **N**-Neutral, **A**-Agree, **SA**-Strongly Agree

No.	Statement	SD	D	N	A	SA
H1	The system is typically organized in a question answer structure.					
H2	I can access the Mobile learning system from anywhere at any time.					
H3	Course content is consistent regardless of the equipment I use.					
H4	The content provided by the system change to my preference and capability of the device I use					
H5	Do you think the structure and organization of mobile learning system need to be improved?					

H6. Which equipment do you use to access course content on the Mobile learning system? Desktop Computer [] Laptop [] Phone [] Tablet []

H7. How would you wish the mobile learning system to be organized and structured?.....

SECTION I: FUNCTIONALITY FACTORS

What factors if any hinders you from achieving the best from the Mobile learning system (MLS). Tick in the space provided after each statement appropriately.

I1. Lack of skills to use the available Mobile learning system []

I2. Inappropriate content provided by the learning application. []

I3. Lack of required tools in the available MLS []

I4. Poor ICT infrastructure at the university []

I5. Availability of the Mobile learning system []

I6. Network access speeds []

I7. The available application of mobile learning system is hard to use []

I8. Poor organization and sequencing of course content []

I9. Accuracy of the content provided by the mobile learning system []

I10. Type of content published on the web-based e-learning system. []

I11. University policies and culture []

I12. Kindly specify any other factor that determine functionality of the
system.....
.....
.....
.....

Thank you for taking time to fill this questionnaire.

APPENDIX A: INTRODUCTION LETTER



MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

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P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

Date: 12th July, 2021

Mogaka Sarah Kemunto,
SIT/G/10/09
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms. Mogaka,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled: "*Usability Evaluation Model for Mobile Learning Systems*" and appointed the following as supervisors:

1. Dr. Collins O. Odoyo - School of Computing and Informatics, MMUST
2. Dr. Raphael Angulu - School of Computing and Informatics, MMUST

You are required to submit through your supervisor(s) progress reports every three months to the Director Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Computing and Informatics Graduate Studies Committee and Chairman, Computer Science Department. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

Dr. Consolata Ngala
DEPUTY DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

APPENDIX B: RESEARCH PERMIT

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 974903	Date of Issue: 27/October/2021
RESEARCH LICENSE	
	
This is to Certify that Ms. sarah kemunto mogaka of Masinde Muliro University of Science and Technology, has been licensed to conduct research in Nakuru on the topic: Usability Evaluation model for mobile learning systems for the period ending : 27/October/2022.	
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APPENDIX D: LIST OF PUBLICATIONS

1. **Mogaka Sarah Kemunto**, Collins Odoyo and Raphael Angulu, “system efficiency on mobile learning systems user satisfaction at Egerton University, in Kenya”.international Journal of Communication and Information Technology, 2022;3(1):22-24. E-ISSN: 2707-6628